UNIVERSITY OF SASKATCHEWAN

College of Engineering

G.E. 120.3

Introduction to Engineering II

FINAL EXAMINATION #1

February 28, 2005

7:00 PM - 9:00 PM

STUDENT NAME: _____

STUDENT NUMBER: _____

LECTURE SECTION: ☐ L02 Tu-Th 11:30 – 1:00   Prof. H.C. Wood

☐ L04 Tu-Th 1:00 – 2:30   Prof. T Fonstad

☐ L06 Tu-Th 2:30 – 4:00   Prof. D. Chen

Question 1	/ 10
Question 2	/ 15
Question 3	/ 15
Question 4	/ 20
Question 5	/ 20
Question 6	/ 10
TOTAL	/ 90

GENERAL INSTRUCTIONS FOR THE QUESTIONS

1) **NO** textbooks, **NO** notes, **NO** assignments, and **NO** laboratory logbooks/reports.

2) **NO calculators allowed**.

3) Neatness counts. Please ensure your paper is readable.

4) Some questions contain special instructions. Please ensure that you read these carefully.

5) Not all questions are of the same difficulty and value. Consider this when allocating time for the solution.

6) *IF A QUESTION PROVES TO BE TOO HARD FOR YOU TO SOLVE, GO ON TO ANOTHER QUESTION! RETURN TO THE TROUBLESOME QUESTION WHEN TIME PERMITS.*

PLEASE NOTE

ALL parts of the examination paper MUST be handed in before leaving.

Please check that your examination paper contains x pages TOTAL.

QUESTION #1
MARKS: 10 (1/2 x 20)

SHORT ANSWER

1. The Accreditation body for the College of Engineering at the U of S is (circle the correct letter):

    a) CTAB
    b) ABET
    c) ENGR
    d) CEAB

2. A good engineering design always follows steps 1-10 of the design process sequentially (circle the correct answer).

    TRUE / FALSE

3. The step in the design process where a method is established to compare and rank solutions, to find the best one, is called _____ .

4. At which step of the design process does 'Brainstorming' occur? _____ .

5. Which step of the design process is often NOT done by an engineer? _____ .

6. At which step in the design process does data gathering occur? _____ .

7. For the following table, place a check mark in the correct column. All questions refer to Log Books.

	Required	Recommended	Never
Number on each page			
Date on each page			
Staple computer output/printouts into logbook			
Errors must be completely erased			

Fill in the Blanks:

1. List the three (3) area of Engineering that the Geological Engineering program prepares students for.

    a)_____

    b)_____

    c)_____

2. In the Chemical Engineering lab, the processing plant incurred three (3) main expenses due to having to descale the reboiler/heat exchanger every 90 days. List the three expenses.

    a)_____

    b)_____

    c)_____

3. From the Mechanical Engineering presentation and lab:

    a) What is the difference between Mechanical and Civil Engineering?
    _____

    b) Where was the micro-machined gear mounted?_____

    c) What keeps the electron beam centered in the synchrotron storage rings?_____

    d) What number needs to be greater than 10,000 for turbulent flow?_____

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QUESTION # 2
MARKS: 15 (4 + 4 + 4 + 3)

Short Answer

1. Evaluate each of the following determinants. (Look for shortcuts in each case.)

a)
$$\begin{vmatrix} 100 & 200 & 300 \\ 18 & 36 & 54 \\ 1 & 5 & 0 \end{vmatrix}$$

b)
$$\begin{vmatrix} 1 & 2 & 0 & -7 \\ 0 & 2 & 12 & 4 \\ 0 & 0 & 3 & 2 \\ 0 & 1 & 5 & 1 \end{vmatrix}$$

2. Find the value of m such that the following equation is correct.

$$\begin{bmatrix} a & 1 \\ -1 & 0 \\ 3 & 0 \end{bmatrix} \begin{bmatrix} 2 & 0 & 1 \\ m & 1 & 3 \end{bmatrix} = \begin{bmatrix} 5 & 1 & 4 \\ -2 & 0 & -1 \\ 6 & 0 & 3 \end{bmatrix}$$

3. Using Cramer's rule, solve for x_1 and x_2 for the following equations

$$a_1x_1 + a_2x_2 = 0$$
$$b_1x_1 + b_2x_2 = m$$

4. Evaluate $A^2 - 5A + 4I$ if

$$A = \begin{bmatrix} 1 & 7 \\ 0 & 4 \end{bmatrix}$$

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QUESTION # 3

MARKS: 15 (4 + 4 + 4 + 3)

SHORT ANSWER

1. Find the Eigenvalues of the matrix

$$\begin{bmatrix} 5 & -2 \\ 4 & -1 \end{bmatrix}$$

2. Find an Eigenvector corresponding to each of the Eigenvalues in #1 above.

3. Given A, B, and C as follows, evaluate D.

$$A = \begin{bmatrix} 1 & 2 & -1 \\ 3 & 2 & 1 \\ -2 & 1 & 1 \end{bmatrix} \qquad B = \begin{bmatrix} 2 & 3 & 1 \\ 2 & 1 & 2 \\ 1 & 3 & 1 \end{bmatrix} \qquad C = \begin{bmatrix} 3 & -1 & 2 \\ -2 & 3 & 1 \\ 6 & 2 & -2 \end{bmatrix}$$

$$D = A(BC) - B^T A^T + AB - (A+B) - (AB)C - BA + (AB)^T + (B+A)$$

4. **For the matrix D above, evaluate:**

   rank = _____   trace = _____   order = _____

QUESTION #4

MARKS: 20 (10 + 5 + 5)

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A system of three linear equations is given as follows:

$$
\begin{aligned}
x_1 - x_2 - 2x_3 &= 1 \\
-3x_2 + 2x_1 - 5x_3 &= 0 \\
5x_3 + 3x_2 - x_1 &= 0
\end{aligned}
$$

Do the following for the system:

a) Find the inverse of the coefficient matrix using the Gauss-Jordan method.

b) Solve the system of equations using the inverse matrix found in (a) above.

c) Write the MATLAB commands to solve the system using the inverse matrix method.

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QUESTION #5

MARKS: 20 (15 + 5)

1. **Determine [A]$^{-1}$ using the Adjoint Method if matrix A is given by:**

$$A = \begin{bmatrix} 2 & 0 & 3 \\ -1 & 4 & -2 \\ 1 & -3 & 5 \end{bmatrix}$$

2. **Show by calculation that [A]$^{-1}$ really is the inverse of [A].**

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QUESTION #6

MARKS: 10

Word Problem

One weekend, several people go on a bus tour to Regina. One half of the men, women, and children, respectively, go shopping together at the mall, while 5 men and 3 women go to the casino. One quarter of the men, women, and children, respectively, go together to a movie theatre, while the rest of the people tour the parliament buildings.

If there are twice a many women than children on the bus, and the number of men on the bus is equal to the sum of the number of women and children, and 24 people go shopping, how many men, women, and children went on the bus. Use matrix methods, and Gauss Elimination, to solve. Explain your reasoning.